Avery Island Salt Works
AKZO Salt Inc.
Avery Island
Iberia Parish
Louisiana

HAER No. LA-9

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

Historic American Engineering Record
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HISTORIC AMERICAN ENGINEERING RECORD

AVERY ISLAND SALT WORKS

HAER NO. LA-9

LOCATION: The Salt Works is part of the AKZO Salt Inc. site, Avery Island, Iberia County, Louisiana.

UTM: 15/605200/330740
Quad: Delcambre, Louisiana

DATE OF CONSTRUCTION: 1898-1899

PRESENT OWNER: AKZO Salt Incorporated, Avery Island, Louisiana.

PRESENT USE: Both the Steam Hoist and Breaker Building are still used in the salt mining and crushing operations. The Hoist lifts personnel and light machinery, while the Breaker houses modern crushing and grading machinery.

SIGNIFICANCE: The Steam Hoist is the oldest still operating in the United States and has a history of ninety years of continuous use on the same site. The Breaker Building is one of the few surviving examples of this type of timber-framed industrial structure. The Salt Works is part of the site of the oldest salt mine in the United States.

HISTORIAN: Richard Terry, August 1989.

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INTRODUCTION

Towering more than 150 feet above the surrounding terrain, Avery Island lies in an area of salt lagoons and marshes in Iberia Parish, Louisiana, at the junction of the western edge of the overflow region of the Mississippi Delta. One of five piercement domes, known as the "Five Islands," which extend along a northwest axis from Belle Isle in the south to Jefferson Island in the north, Avery is oval in shape, 2½ miles long and 1½ miles wide. The Avery salt stock is 1½ miles in diameter, and 8 to 12 miles in depth, comprised of two spines of pure salt, dissimilar in purity, composition, and deformation, and separated by a shear zone of impure sediments.[1] This shear zone structure has influenced the pattern of mining over the past 90 years.[2].

Salt domes began forming in the Mesozoic era, as a result of a process of deformation occurring within a strata of mother salt buried deep beneath the earth; a column of salt is forced through the layers of overlying material, occasionally piercing the surface. The range of domes to which the Five Islands belong evolved in the early Tertiary Period.[3]

North American salt domes exist in two regions: the Isthmus of Tehuantepec in Mexico; and the Louisiana-Texas area. The latter is divided into the Coastal and Interior groups, with the Five Islands chain lying in the Coastal area, which extends 70 miles inland. Each dome consists of a salt core, with or without cap rock, and overlying strata of disturbed material.[4] There are well over four hundred salt domes in the northern Gulf Coast region, but few reach the heights of Avery and the other Islands.

EARLY SALT PRODUCTION ON AVERY ISLAND

Archeological evidence for the production of salt by prehistoric Native Americans suggests that salt has been made on Avery Island from at least AD 1000 by early Plaquemine peoples.[5] Artifacts such as basketry and shallow ceramic pans for evaporating brine have been found in the Salt Mine Valley on the south side of the island, pointing to occupation during a period between AD 1300 and 1650.[6] The Attakapa were the last Native Americans to inhabit the island, but they abandoned it before the arrival of Europeans.[7]

The historic Attakapas district, of which present day Iberia Parish is a part, was first inhabited by the French in 1778 and, a short while afterwards, by Acadians migrating from Nova Scotia. These settlers established the colony of New Iberia in the 1780s.[8] Among those traveling west from New Orleans at this time was Eliza Hayes, abandoned by her husband, and her five children. The family arrived at Petite Anse Island, later to become known as Avery Island, in 1789 and established a homestead on the high, level ground on the north side. Local

tradition maintains that in 1791, while hunting for deer, Eliza Hayes' eldest son John discovered a brine spring in the southern portion of the island. From this time the family began to evaporate salt for their own use.[9] In 1811 they received title to 338.51 acres of land on the north side where they had made their home.[10]

At this time the occupant of the southern side was Jesse McCall.[11] It is believed that McCall established a brine boiling plant there in 1812, under economic conditions made favorable by the war between the United States and Great Britain which forced up the price of salt. The product was distributed to the surrounding area, including the settlements of Attakapas and Opelousas, and transported by boat in sacks to New Orleans.

In 1818 McCall sold his property to William Stone and John Craig Marsh for $15,000. Stone and Marsh continued the salt evaporating works until 1830, when it was abandoned due to the wide availability of cheaper Liverpool salt in New Orleans after the war.[12] Until the Civil War, the economy of Petite Anse Island was dominated by sugar plantations, with two sugar houses established by 1844, owned by Marsh and Hayes respectively. By 1836 Stone had sold all of his share of the property to Marsh, and Marsh had acquired most of the island by 1840, at which time he returned to his native New Jersey leaving his Louisiana plantations in the hands of his son-in-law, Daniel Dudley Avery. Avery owned the island plantation by 1859.[13]

CIVIL WAR SALT PRODUCTION

The nine million people living in the Confederate States at the time of the outbreak of the Civil War relied chiefly upon New Orleans for supplies of salt; one quarter of the imports of English rock salt entered through the port, a yearly average for the years 1857-60 of 2.1 million bushels.[14] By autumn of 1861, the half million sacks that had reached New Orleans between 1860 and the Union blockade of May 1861 were exhausted.[15] The Confederate army was dependent upon the salt supply, particularly to preserve the beef, mutton, and pork which formed a staple in its rations.[16] Salt was obtained from the alternative sources of artesian brine springs or the evaporation of sea water, but there were no rock salt mining operations in the entire American continent at this time.[17]

The increased demand for salt prompted Judge Daniel Dudley Avery to re-open the brine spring evaporation process on Petite Anse in late 1861, entrusting the day-to-day running of the site to his son, John Marsh Avery.[18] The enterprise seems to have been immediately successful, the evaporated salt selling in New Orleans at $11 in gold per sack.[19] An article in a New Orleans newspaper attested to this success:

> We have received a specimen of the salt manufactured by John M. Avery at his Island Salt Works in St. Mary's Parish. It is of the

> purest, whitest, finest we have ever seen. This enterprise of Mr. Avery is a most important one, as indeed is every enterprise the effect of which is to supply us with any of these articles of necessity, for which we have hitherto been dependent upon the North, but which we must now make for ourselves.[20]

It was during the cleaning and deepening of one of the Petite Anse springs that solid rock salt was struck in May of 1862 at a depth of only 16 feet below the surface, the first rock salt find in the United States.[21]

The pit was worked during the summer of 1862, and by September had caught the attention of the various Gonfederate States. Governor Pettus of Mississippi telegraphed President Jefferson Davis with the news of a salt mine near New Iberia, Louisiana, which was being worked with few hands. Pettus suggested that the mine be controlled by the Government, and a thousand hands put to work, his justification being that "Salt for all the Gonfederacy is there."[22] Governor Shorter of Alabama, concerned about the danger of a salt famine, dispatched a representative to Petite Anse with a fund of $20,000. He purchased 155,950 pounds of salt for $6,447, and at the same time contracted with the Averys to provide labor to mine salt at the same price.[23] An agent of Governor Pettus also visited the mine in September 1862, and reported that the salt was being shipped down the Bayou Teche to the Atchafalaya, thence to the mouth of the Red River, but that the prospects for supplying the State of Mississippi with salt were not good; the only shaft that had been sunk was a pit 20 feet by 30 feet, and 14 feet deep into solid rock salt. He also noted that prospecting had uncovered salt to a depth of no more than 30 feet over an area 70 yards around the pit, and, despite the high cost of salt, contracted with the Averys to organize and work two hundred hands at 3 cents per pound; "ruinous terms" he claimed, declaring that he saw "...no hope but in the seizure by the Government." There were also problems with the speed of extraction, given the relatively small labor force available to John Avery.[24]

Whatever the truth may have been concerning the relative expense of the salt, the Gonfederate Government decided that the mine had too much strategic significance to be left in private hands, and moved in its own labor force to dig two pits.[25] Between the autumn of 1862 and April of 1863 a further seven pits were sunk, in addition to the two Government pits and the original John M. Avery pit. These pits were divided up amongst the States of Alabama, Georgia, and Mississippi, the town of Opelousas, and private individuals including Judge D.D. Avery.[26] Production increased dramatically: it is estimated that output during 1861-2 totalled 200-500 short tons of salt, rising to 10,000-30,000 short tons between September 1862 and April 1863.[27] During this period steam engines were installed, either to pump out water infiltration or as steam compressing engines for drilling machinery.[28]

The island's only link with the mainland was a raised plank road built through the marsh. Teams and vehicles could not pass each other on it, and a system was devised whereby certain hours of the day were set aside for travel in one direction only. The teamsters unloaded at New Iberia, transferring barrels of salt to a steamer, and thence to Vicksburg, Port Hudson, and other Gonfederate

strongholds by river.[29] The shafts were rectangular excavations walled up with planks or a dovetailed framework of logs, surrounded by heaps of salt 15 feet high. They averaged 20' X 20', although one of the Confederate Government's pit was much larger; this was an 'L'-shaped hole, 80 feet and 60 feet along its length, and 20 feet wide. The pit had been taken down to 33 feet, and then undercut, with a 6-foot-diameter column of salt supporting the roof; extraction was done by drill and powder blast, and it was said that the face was as hard and difficult as granite to work. Machinery for barreling salt blocks was contained in the buildings erected over and around the pits, and up to five hundred teams from all parts of the Confederacy waited in turn to be loaded with barrels. Four hundred men were employed day and night to do this work, the salt being paid for immediately at an average price of 4 cents per pound; Liverpool alum salt in New Orleans had been a ¼ cent per pound before the blockade.[30]

On April 16, 1863, the Federal army attacked Avery Island, encountering little resistance, and destroyed the eighteen buildings on the mine site, together with the steam engines, windlasses, mining equipment, and six hundred barrels of salt awaiting shipment.[31] The Avery family fled to Texas to escape the Federal soldiers, and operation was at a standstill once more.[32]

THE FIRST ROCK SALT MINE

The Avery family returned from exile after the War with insufficient capital to operate the mine. However, owing to a detailed report by Samuel Hotaling, a Union agent who had visited the site shortly after the island had been captured by the Union army, the Federal Government commissioned a Bureau of Mines investigation into the possibilities of extending the operation on Petite Anse. The ensuing report, published in 1867, explicitly rejected the open pit method of mining which had hitherto taken place, due to the chances of contamination and water damage, and to eliminate the cost of drying the salt. The report was adamant on the type of mining envisaged:

> Indeed, there remains but one method of permanent mining; namely that by well-constructed shafts, and protected galleries in the salt itself. The extraction of salt will be carried on by workings upon the plan of so-called compartments or squares supported by walls and pillars, as in the mines of Wieliczka in Poland, and of Vic and Dieuze in the east of France.[33]

Several significant practical suggestions as to the operating of any future mine were made; in particular the use of nitro-glycerine rather than powder in blasting was felt to be important to guard against unnecessary contamination of the salt, and the use of undercutting machines as used in European coal mines. Assuming the salt to be a stratified layer, the report also suggested that the shaft be sunk no deeper than 300 feet to defer expenses, a method which later led to the flooding of the mine due to insufficient depth of salt above the

galleries.[34]

The provision of a means of processing the salt was to be made by the installation of a mill at the shaft head, and other necessary equipment was outlined in a projected expenditure list: T-rail underground haulage tracks and cars; a 25 h.p. steam engine, pump and winding gear for the main shaft; horse-powered whims for two subshafts; and a railroad to a projected landing on the bayou. The projected transportation included carriage of salt by schooner to New Orleans or Galveston, and the construction of a railroad spur to link up with the existing rail network which was planned to run through New Iberia.[35]

Although the report stressed the importance of deferring investment in the railroad until returns on initial investment were recouped, it was made clear that with the low distribution costs associated with bulk rail haulage Petite Anse salt would be able to compete with foreign and domestic salt production. By estimation, the Island's salt could undercut foreign imported salt by up to fifty percent, with or without a trade tariff. The market demand for salt at the time consisted of fine-grain evaporated salt for dairy use, and coarse crystal solar pan or rock salt used in packing; table and domestic applications used both. Most other domestic production at this time was evaporated salt, and therefore operations on Petite Anse would only have to compete with foreign imports of rock salt.[36]

In 1867, the same year the Bureau of Mines report was published, Charles P. Chouteau of St. Louis, in partnership with a Mr. Price, sank a shaft 90 feet into the salt. It may well be that the report was prompted by the interest shown in a possible mining venture by such entrepreneurs. The 8-foot-square shaft ran only 58 feet below the salt, in the belief that the salt was at a constant 20 foot depth below ground level; in fact it sank below ground up to 100 feet within 200 yards of the shaft.[37] The mine was located in the valley where the Civil War production pits had been, and through which ran several streams which collected run-off from the surrounding higher land. According to one visitor to the mine, Chouteau and Price constructed the mine according to "scientific principles."[38] The horizontal galleries extended from the shaft in opposite directions for 200 feet, and were 30 feet wide with an arched roof 10 feet high at the crown:

> A railway for transporting the blocks of salt to the shaft runs along the axis of the gallery. On either side of the railway is piled hundreds of tons of pure salt in blocks varying in size from the smallest fragments to huge masses weighing 200 to 300 pounds. In the far ends of the gallery the miners, with their mining lamps burning on their heads, are still picking away with their sharp instruments, or boring deep holes for a blast, or wedging out some huge block already loosed from its bed.[39]

From this description it would seem that at least some of the Bureau of Mines recommendations were followed, in particular the arrangement of the work faces on a room and pillar basis. However, instead of being milled on site, the mined salt was shipped through the Petite Anse Bayou 1¼ miles from the mine; Hilgard's

map of 1871 shows the "shaft house" but no other buildings or supporting structures. Six "miners' houses" had also been built close to the mine by this date.[40]

Chouteau and Price had arranged to pay Judge Avery $2.00 per ton of salt sold, but when the war tariff on salt imports was lifted in 1869 and salt prices fell, the mine could not reach an agreement with Avery for a lowering of the royalty. In view of this, and the death of Price in 1870, the mine was abandoned in the early 1870s.[41]

Mining was taken up again in 1879 by a Charleston and St Louis company, which made initial capital investment in dredging the bayou and constructing a short canal to a new barge dock. A tramway was built from mine to dock, the company's barges transporting sack-packed or bulk salt from mule-hauled tram cars to schooners anchored offshore in Vermillion Bay. The workface was modified by increasing the height of the galleries to 25 feet with 40-foot-square pillars, and gallery width to 40 feet. Unfortunately the venture suffered from several strategic disadvantages, including the complicated procedure of transferring the salt twice before it reached the bulk transportation route, and also the unreliability of navigation in the bayou, with its mud flats and other blockages. As a result, the company was forced to merge with the New York-based American Salt Company in 1880.[42] Total production of salt since 1868 had only been 5,000 short tons, a small proportion of the amount mined during the Civil War.[43]

The American Salt Company erected a crushing mill at the shaft soon after taking over the mine, installing "a large quantity of the most modern machinery," and operated the tramway and schooner dock system, investing in new canals, barges, and steam ships.[44] The breaker building containing the milling machinery was about 70 feet high, much smaller than the later 1899 building, and yet with a similar form: hoist gear housing; mill; and warehousing at right angles to the main block. The hoist house was four stories, and the main breaker block two stories high. The boiler and engine houses faced the front of the breaker, with other single story additions clustered around the main block.[45] The salt was hoisted 60 feet above ground and dumped into a crusher consisting of two sets of corrugated high speed rollers before being ground into various grades by six horizontal burstone mills, 36 inches in diameter running at 350 r.p.m., each grinding 50 tons in a ten hour shift. The ground salt was sorted by jigs (horizontal screens), revolving reels, and blowers which blew fine dust away. The salt ran into barrels or sacks and was stored in readiness for transfer to tramway cars. Apart from the hoisting engines, three other steam engines powered the mine ventilation fan, blower, reels, crushers, mills, and screens, 250 h.p. in all.[46]

The salt was ground to be marketed in eight grades:

1. Rock salt in 100-300 lb. lumps for cattle licks.
2. Crushed salt over ½-inch screen size, under ¾-inch size.
3. "Fish Salt" - salt passing through ½-inch screens.
4. Coarse Ground.
5. Medium Ground.

6. Fine Ground.
7. Sack and Barrel salt - Fine Ground screened with 10 mesh to the inch; fine dust blown out.
8. Coarser fine dust for table salt.

This was a relatively sophisticated and extensive range of products compared with the output of the mine a few years earlier. Salt from the mine had been tested extensively by a number of the largest meat packers of the north and west, who became the main customers of the mine. The Louisiana and Texas Rail Road, linking New Iberia with Galveston, New Orleans, and Mobile, was completed in 1880, and salt was transferred to these ports as well as the meat packing centers of the Midwest: Kansas City, St. Louis, and Chicago. The success of the three years of the American Salt Company's stewardship of the mine is demonstrated by the production figures; in 1881, 15,000 short tons of salt were shipped out, and by 1883 this figure had risen to 37,130 at a value of $141,124.[47]

The mine ran on a 50 percent royalty contract with the landowners until 1883 when the company was reorganized as the New Iberia Salt Co.[48] The problems with water infiltration of the mine also began in this year; the inequality of the surface of the salt left some galleries exposed to seepage of water entering through crevices and dissolving the surrounding salt. This led to the formation of the first sink hole, in which the surface soil collapsed into the cavity created by the process of salt dissolution. Water, sand, and debris were carried into the mine and interfered with the operations. As a response to these problems, the mining company in 1885 sank an additional shaft 78 feet deep below the existing shaft to give a working level 160 feet deep with an 8 foot sump, and two pumps were used ten hours a day to remove the still-incoming water. The galleries driven on this level were larger, being 200 feet long, 80 feet wide, and 70 feet high, with pillars 60 feet in diameter. The pillars were aligned so that the upper level pillars were directly above, with only 25 feet of rock between them.[49]

The technique of mining consisted of undercutting 6- to 8-foot high galleries 200 feet in length, and blasting down the roof until it reached 20 feet in height. Holes were bored horizontally with an auger of German design, imported along with the workers who were largely from the Stassfurt salt mines in Prussia; the blast holes were packed with dynamite and the mass of salt shot down. The chunks of salt were then removed in tram cars hauled by mules. A second attack on the roof was made by erecting temporary scaffolds for men and drills to shoot down the highest remaining mass of salt, an operation which was repeated until the roof was 70 feet high; the roof adjacent to the pillars was left at 60 feet to create a shallow arched vault. Chunks in danger of collapse were broken from the roof. Two chambers were worked simultaneously: while one was being undercut, the other, with most of the roof down, was used as a reserve until the next undercut was underway, as a single undercut would not supply the mill with sufficient quantities of the coarsest grade of salt.[50]

The miners earned a skilled worker's wage of $3 per ten hour shift, laborers $1.75, the total workforce being one hundred, of whom fifty were underground. Conditions in the mine, while certainly hazardous, were nevertheless far more comfortable than in a stratified mine; the temperature was a constant

75 degrees and the mine was ventilated by a steam driven fan 8 feet in diameter. There was little trouble with pockets of gas: if any gas was struck, it was burnt off in less than an hour.[51]

Regardless of the difficulties with the underground flooding, the company sought to invest in a surer form of transportation for their milled and packaged salt. They made arrangements with the Louisiana and Texas Rail Road to construct a spur from the mine to the main line at New Iberia, a project completed in 1886. Because the earlier breaker building had not been designed to cater for rail transportation, the railroad ran to the rear of the building, where presumably a loading bay had been erected.[52] The effect of the railroad was to decrease cost rather than to increase volume: production remained relatively constant at around forty thousand tons per year until 1891 when the upper level was abandoned. One quarter of this production was used for capping pork and beef in the northwest, one quarter in the Chicago and St. Louis markets for refrigerating and hide salting, the rest for local demand and adjoining states. Much of the production and marketing structures of the mine therefore followed quite closely the recommendations of the Bureau of Mines report of 1867. The discovery of rock salt in Kansas in 1888, however, led to a partial decline in the demand for Avery Island salt in the north.[53]

In 1893 the New Iberia Company gave up the lease to the mine and was succeeded by Myles and Company of New Orleans. Its operation was short-lived as water infiltration led to the abandonment of the lower level by 1895 and the reworking of the upper level until 1896; at this point the lease expired by default of contract, which had stipulated a minimum output of 130 tons per day. The mine was taken over by the Avery Rock Salt Mining Company, organized by the Avery family, which set about planning a new mine adjacent to the old. Large sink holes appeared at the edge of the breaker building and engine house in 1896, leading to the complete abandonment of the original mine site by 1898.[54]

ROCK SALT MINING IN THE 1890s

After the Civil War the demand for salt expanded greatly. The artificial soda industry was established in 1882, consuming about half the total salt produced in the U.S. by 1900. Soda was an important raw material in the paper, soap, glass, and textile industries and in oil refining and water treatment. In the period 1875 to 1890 U.S. production of salt by all means - mining and evaporation - grew by 280 percent compared with 12 percent in Great Britain and 73 percent in Germany, the nearest competitors at the time. This rate was almost sustained in the following thirty-five years as the United States underwent heavy industrialization.[55] In the ten years following 1883, domestic production replaced much of the imported salt in the U.S. market; the renewed tariff was lifted in 1894. At this time 13 percent of all salt produced was rock salt.

The earliest mine apart from Avery was begun in Retsof, New York, in

December of 1885, with three more established in Louisiana in the space of seven years; the Kansas ranges, discovered in 1888, were also being exploited by 1890, and mines in Michigan were developed at the same time.[56] It was against this background of expansion and development that the Avery Rock Salt Mining Company made its decision to sink a new shaft in 1898. In 1897 a Tariff Act had returned salt to the dutiable list, and 1898 saw an unprecedented rise in the output of the industry, dominated by the New York and Michigan mines and evaporation plants. A 15 percent increase in price accompanied a 100 percent increase over the production figures of 1888. The United States became the world leader in salt output in 1897 with 20 percent of total supply, outproducing Great Britain, Russia, and Germany.[57] The rise of the American salt industry was a special case rather than the norm in the U.S. economy at the time, as one knowledgeable observer noted,"[t]here are few industries in the United States which have presented more regular growth during the twenty years covered by this series of reports than that of salt production."[58]

The fierce competition for markets led to many salt makers selling at cost or even at a loss, and there were a number of mergers. Rock salt mining, however, only occurred in any great size in New York, Kansas, and Louisiana. The Avery deposit had the added strength, as far as the market was concerned, of a high degree of purity - 99 percent pure sodium chloride - and therefore relatively lower cost because of the absence of any filtering and cleansing processes.[59] Consequently the capital required to develop a new mine and mill on Avery Island may have been less than elsewhere.

AVERY ROCK SALT MINING COMPANY

The Avery Company's shaft was sunk in 1898 to a depth of 518 feet. The lessons of the previous mine with its shallow workings had been well learned, and this time the mine engineers planned to have a roof of salt about 400 feet thick above the workings. The shaft entered the salt at a depth of 54 feet, but throughout 1898 and 1899 problems were encountered with water infiltration between the timber lining and the salt, exacerbated by water-bearing sands and gravels above the salt deposit. The shaft was built as a tripartite structure, with two hoist cavities and a third cavity for ventilation and drill pipes, the dimensions being 21 feet by 10 feet.[60] At the same time the shaft was being sunk, the breaker building was being erected above it.

Salt mine geology was not well understood in 1898 and, although the early workings were well planned, the actual process of mining was conducted with great caution, especially in view of the failure of the earlier mine. Longer than normal drills were used in order to determine in advance the extent of the salt, its purity, and water content. The miners gradually built up a practical knowledge of the tolerances of the salt stock and were able to modify their methods of working and increase the size of the rooms and pillars.[61] The proposed structure of the mine in 1900 was to have the shaft at the center of a

series of gangways and galleries. The gangways acted as main airways and tramway linkages, with a grid of 30-foot-square rooms and pillars extending from them in all directions.[62]

When the mine was in operation the tramway system ran centrally through the wide galleries to the workface. The method of cutting the pillars and galleries followed that used in the earlier mine; a 10-foot-high, 30-foot-wide undercut was made by drilling and blasting, and the salt removed in timber cars hauled by mule, the tramways arranged so that an incoming and outgoing line lay side by side. The compressed air drills were set on a tubular jack about which they could pivot, and which was wedged into the ceiling and floor to provide a solid drill platform. Using the pivot, a series of holes were drilled into the vertical wall of salt, and when blasted down the roof was left with a distinctive fan-tail shape of drill grooves. Each face required several dynamitings at different heights to reach the full gallery height, and this was achieved by mounting the drill jack on piles of salt which gradually became taller with each successive blast. Each of these stages created a step in the workface known as a bench, the eventual height of the roof being 60 feet.[63]

A mine map of 1921 shows to what extent the plan of 1900 was carried out. The older workings lay to the south of the shaft, and followed the 1900 proposal in form. To the north of the shaft, though, the pillars became much larger, moving in four phases from 35 feet by 40 feet to 90 feet by 65 feet, the larger pillars being the northernmost, this being the direction of development. The increased size of the workings created a need for a more efficient means of ventilating the mine, and an air shaft was sunk in 1921, although it was not connected with the main workfaces until a year later. This development coincided with the electrification of the mine and salt works, and electric fans were used to draw air through the galleries for the first time.[64]

The electrification of the mine brought with it a host of new machinery and equipment. Three-foot-gauge electric locomotives were used for haulage; the galleries were lit with electricity; new electric drills were introduced, driven by two gasoline-powered air compressors; and shortwall mining machines were used to make undercuts. The latter machines ran on rails and had an 8½ foot cutting extension with tempered steel blades attached as in a chain saw. These machines could be driven to the work face and used to cut a 75-foot-wide slot, 8½ feet deep, 6 inches wide, at a rate of 6 inches per minute. This slotted undercut gave a blast expansion gap, and allowed a high wall of salt to be blasted relatively quickly, since blast hole drilling continued while the undercut was being made. Each shot brought down nine hundred tons of salt, which was loaded onto cars by electrically powered Marion shovels, mounted on caterpillar tracks. The locomotives and undercutters received electricity from an overhead cable on the main line, but operated on a cable extension when at the salt face. Power was generated on the surface, and transmitted as AC by cable to a rectifier, which converted the current to DC for the underground equipment.[65]

In a 1929 mine map, the old workings are shown as "abandoned" and show no signs of development since 1921, suggesting they were unworked at that time. The mining had moved southeastward in an irregular fashion, and had begun to move

northeastward. Large areas of irregular shaped rock were left as pillars, although there were several regular pillars approximately 75 feet square, and the gallery height remained 60 feet. The increase in size of pillars and galleries was probably due to the combination of better knowledge of the tolerances of the rock salt, the more efficient and powerful machinery in use, and to the geology of the 500 foot level, in which the salt contained many small areas of impure intrusions and water infiltration. There were over two miles of galleries at this time, and mules were still used as an auxiliary to gather cars for the electric locomotive, although this practice was discontinued by 1931.[66]

By 1934, 75 percent of the salt stock was being extracted and hauled to the foot of the shaft in a train of fifteen to twenty mine cars. The maximum capacity of the breaker was one thousand tons per day and as three hundred tons of salt was removed for each foot advanced in a 75 foot room, the mined area and track length was relatively small. Consequently, significant expansion was held back by the surface machinery. By 1938, the total mined area was about sixty acres, primarily in the south east sector. By this time, the pillars were being given a more regular shape and alignment, probably owing to the nature of the salt in this area. An area to the north was marked off for future development, planned on a rigid grid with 75 foot pillars.[67]

Between 1953 and 1955 a major modernization of the mine took place, with the installation of a belt conveyor system for salt haulage from the face to the shaft. A portable crusher ground the salt at the face, and the salt was gathered, weighed, and sent to the surface automatically. This dramatically altered the production figures from one thousand to three thousand tons per eight hour shift, and allowed the work force to be cut by one third.[68] The mine was deepened to 770 feet in 1965, using a slope from the 518 foot level, and in 1972 a new production shaft was sunk to 880 feet. An 1100 foot level is now being worked, and a 1300 foot level is currently being opened up. Both lower levels are connected to the 770 level by slopes, which form ramps for the diesel powered drill rigs, shovels, and dump trucks which are now used in the mining operation.[69]

THE BREAKER BUILDING

CONSTRUCTION

The breaker building was erected in 1899 as a set of discrete units each with a different function, although contributing to a working system. The entire construction operation, including the installation of the machinery, seems to have been the work of E.H. Park, Constructing Engineer of New Orleans, and consisted of an enlargement and modification of the previous breaker building above the first mine.[70] The site for the building was leveled by hand, using mule-hauled sledges for the removal of tons of earth, and a railroad spur laid

to the foundations, with two sidings over which the loading bays were to be built. It is not known whether the spur brought in either ready-wrought timber, which was jointed and drilled for peg holes on site, or timber pre-jointed elsewhere and merely assembled on arrival. Each timber member was hoisted into place by a single pulley block hoist attached to the highest part of the structure; this periodically had to be moved higher as the building work progressed. The structure was erected by working from the lowest part of the central block and moving upwards to the hoist frame. The warehouses on either side of the building were then completed and clad with timber siding before the final cladding was attached to the hoist frame; both external and structural timbers were cut from long-leaf yellow pine.[71]

The breaker building was designed to support and contain a gravity-flow process. To this end, the structure can be broken into four areas, each of which has a characteristic form and function. The head stock was designed to hold the two sheaves and provide guidance for the ascending and descending cages, and as a result was supported by diagonal bracing. The primary breaking and grinding area, occupying the three taller bays of the building, was also designed to contain the main drive wheel for the grading machinery. The screen separators and salt bins were installed into the first two bays of the lower eastern portion of the building, the final bay being reserved for fine milling machinery, stamp mills, and an additional breaker. The warehousing was positioned on either side of the final destination of the processed salt, the bins, from which it could either be bagged and stored, or transferred immediately to box cars, over which loading sheds were built.[72]

OPERATION

The Avery Rock Salt Mining Company was incorporated into the International Salt Company in 1901, the latter being a New Jersey registered company with headquarters in Scranton, Pennsylvania. There may well have been a connection between these two companies before their merger, as International owned the Retsof mine in New York State which had been operating since the 1880s, and whose breaker building bore great similarity to that recently erected on Avery Island.[73] The purpose of the breaker building was to hoist the salt from the mine, break down the larger chunks, crush smaller chunks to crystal size, grind crystals to finer particles, and package and load the finished product. The two balanced cages sent a virtually continuous flow of salt from the mine, hauled up in 3½ ton loads in timber mine cars. At the hoist head the cage was stopped and the car hauled by hand onto a tipple which lifted and opened the car allowing the chunks of salt to fall through a sluice onto a set of "grizzly bars." This was a grill made up of iron bars spaced 6 inches apart, and any salt passing through dropped into a hopper and onto a shaking screen. The remaining larger chunks were deposited into the primary crusher and broken between long spiked rolls 36 inches in diameter. The crushed salt was then transferred to a shaking screen which divided the mass into crushed and oversized particles; the crushed was transferred to grading screens, the oversize crushed in secondary crushers,

completing the reduction of the coarser grades. Apart from large uncrushed chunks which sold as cattle licks, the breaker process produced six grades of unmilled and milled salt in 1900.[74]

The original screening and milling equipment was powered by a belt and line shaft system, of which all that remains is a single pulley on the sixth floor of the breaker building. The screens themselves were custom made or designed by the mining company, as were the cast steel crushers. The screens were timber framed with meshes of brass of different gauges from one inch down. The various grades were conveyed around the building by a series of elevators, spiral conveyors, and chutes. The elevators were used to transfer screened salt to the fine mills, and were continuous rubber belts or steel chains with steel buckets. The spiral conveyors were cast iron screws inside a cypress box and were used to convey materials horizontally. The chutes which fed into railroad cars or the warehouse block were 12" X 12" boxes of brass-lined pine. Full and half ironed "Boston pattern" bag cars conveyed bagged salt from the warehouse to the box car loading bays on a 36" gauge railroad on the ground floor of the building; once the box cars had been loaded, they were weighed on a scale built into the track. The transmission system which connected the breaker machinery to the power source was standard line shafting with rubber belt and cast iron pulley drive. The whole system received power from a 16" X 42" horizontal Corliss steam engine which drove a 16-foot-diameter sheave 12 inches wide. The sheave contained four 1½-inch grooves each housing a hemp rope; the ropes were connected to four concentric pulleys of varying diameters, each driving a belt at a different speed. The speed of the belts was further varied by the diameter of the take-up pulley. The rope race ran up the north side of the mill building, and was covered by a timber hood visible in early photographs of the structure but since removed.[75]

A major investment was made in both the mine and the breaker building in 1921 when the entire operation was electrified. A brick engine and generator house was erected in two stages adjacent to the hoisting engine house; three bays were completed first, followed by the remaining four at a later date. This may indicate that generating machinery for the mine was installed first and, after results were found to be satisfactory, generating equipment for the breaker was housed in the extension. Electrical power was generated by one 400 H.P. vertical four cylinder and one 300 H.P. three cylinder diesel engines, built by the Ingersoll-Rand Company of New York City. It is probable that the workload of each engine was dedicated to either the mine or the surface workings. Each engine was direct coupled to an alternating current generator; the larger engine to a 250 kilowatt machine, the smaller to a 168 kilowatt generator. The line shafting system in the breaker building was retained, an AC motor being coupled to the main drive wheel and the Corliss engine abandoned; five smaller motors were attached to various machines throughout the building by belt drive.[76] The attachment of motor drives to machines continued throughout the 1930s as the production processes became more complex and varied.[77]

At the same time as the breaker building was being modernized, new production processes necessitated the addition of several new structures to the original block; from various plans of the site and other sources it is possible to trace this development. By 1909, the southern warehouse had been extended by

two bays. Another of the early additions to the building was a single story salt block press building with a central two story tower, located to the south of the main block. Sanborn insurance plans of the site show the building was erected at some point between 1909 and 1925, and represented the mechanization of one of the grades of salt. Previously salt blocks for cattle were large uncrushed chunks direct from the mine; the hydraulic block press however allowed salt dust, an unmarketable by-product, to be pressed into cattle blocks of a uniform size and weight.[78]

A plan of 1924 shows the original "mill" building with the addition of a warehouse extension to the south wing, and a further warehouse butting the west wall of this wing. By 1931 an additional bag storage room had been added to the east end of the complex, and a sack room to the north of the mill; the southern warehouse wing had its roof removed and an extra story added by this date.[79] The salt making complex changed dramatically in 1932 when the company entered into the manufacture of evaporated salt. The evaporation process provided another method of using salt dust to create a marketable product, in this case table salt. A timber-framed four story pan building was erected in 1932 opposite the north wall of the power house. Vacuum pans which boiled brine with steam were installed, together with settling tanks and rotary driers; gas fired boilers were installed in an adjacent boiler house. The dried salt was milled in a building attached to the northern side of the breaker building, adjacent to the railroad tracks. Both of these new buildings were clad in corrugated asbestos rather than timber, moving away from the traditional construction materials in timber-framed buildings for the first time.[80] In 1938 after a series of delays due to changes in investment decisions, the breaker building and engine house were themselves clad in corrugated asbestos by Taylor-Seidenbach Inc. of New Orleans.[81]

The Intracoastal Waterway, an inland navigation intended to connect New Orleans and the Mississippi with Galveston, Texas, eliminating the unpredictable coastal passage, was open to traffic in Iberia Parish by 1931. A canal was cut through the salt marsh to a turning dock south of the breaker building, constructed between 1931 and 1935; in 1948 three 24-foot-diameter silos were installed south of the main breaker block on the site of the old block press building, and connected to a barge loading conveyor. The silos were used to load the barge while salt was hoisted and milled in order to speed up a process which in any case took two or three days.[82] Later additions to the complex included a new block press building on the south side of the breaker built in the 1940s, and a truck loading dock adjacent to the packaging block of the 1950s.[83]

The entire breaking operation was modernized in 1954, and the line shaft system had been totally removed by June 1955. Crushing and screening machinery had individual electric motor drives fitted, and the hoist cages were replaced by skips which had salt loaded into them directly, depositing their load at the top of the breaker building. The system was replaced in 1972 by a conveyor process running from the new production shaft; this method is still in use today.[84]

The Avery Island breaker building represents an engineered solution to a particular production problem which had a precedent in the breaker building of

the earlier mining operation. This common form seems also to have been reproduced at Retsof, New York, where three-ton cars were hoisted to the top of the mill, dumping their loads into a series of crushers and screens similar to those at Avery Island; this was also the case, with minor variations, at mines in Halite, New York; Detroit, Michigan; and at three mines in Kansas.[85] The local breaker architecture followed a similar pattern; on Weeks Island the breaker, built in 1902, was lower than that on Avery, with long lean-to roofing on either side of the main block, and an Italianate tower over the shaft.[86] The breaker on Jefferson Island, built in 1922, shared the common basic form, with railroad spurs entering the structure on either side of the bins.[87]

THE STEAM HOIST

The hoist is a horizontal twin reversing engine with "D" slide valves, custom built for the Avery Rock Salt Mining Company by the Vulcan Iron Works, Wilkes Barre, Pennsylvania, in April 1899, and transferred to the site on flat bed railroad cars.[88] The hoist was lowered onto concrete foundations from a steel "I" section beam, resting on cast iron pillars and left in place afterwards, presumably for future maintenance purposes. Apparently there was not a safety device fitted to the hoist to prevent over-winding in the event of something happening to the operator until 1930, when the company purchased a Model D "Lilly" safety controller from Vulcan Iron works for $975. Vulcan mentioned in a letter to the mining company that the device was being used throughout the country, especially in coal mining operations.[89]

Steam to power the hoist was provided by two batteries of two 66" X 18' horizontal return tubular boilers, built by the Dickson Manufacturing Company. The boilers were oil-fired, and set in a boiler house adjacent to the engine house and below a trestled railroad spur which brought in fuel.[90] When the evaporation building was constructed in 1932, the new natural gas fired boilers were used to produce steam for the hoist and the older boilers scrapped.

The hoist sheaves were replaced at least once during its working life; in 1929 two cast iron sheaves with wrought iron spokes and cast steel shafts, 8' 10" in diameter, were installed, furnished by the Vulcan Ironworks. These sheaves suffered wear and tear from cable scoring, and in 1939 the mining company replaced their round strand hoist cable with flattened strand ropes as a counter measure. This seems to have been effective, as the flat type cable is still in use today.[91]

The hoist has two reversible reciprocating cylinders with 24 inch bores with a piston stroke of 48 inches running at an average steam pressure of 100 lbs. Each piston is direct connected to the hoist drum via a crankshaft and combination crank- and fly-wheel. Steam enters the side of the cylinder through a large external valve box containing the "D" baffle valves, applying steam to one or the other side of the piston, enabling the crank to be turned in either

direction. The reverse linkage consists of a single cylinder reciprocating engine which operates a counterweighted lever opening and closing valves. The Lilly emergency brake system works off a chain driven governor; the governor breaks an electrical contact if the hoist drum reaches too high a speed, and a counterweighted lever applies the caliper brake wrapped around the drum and cuts off the steam supply. The hoist operator judges the position of the two cages by reference first to a large wooden pointer and disc, and for greater accuracy towards the end of the wind, a pair of taped markers, one on each drum, which align with a yellow line painted on the brake caliper. The drum winds in one direction at an average speed of 34 r.p.m., the two 1½-inch-diameter, 920-foot-long cast steel cables, one underwinding, the other overwinding on a spiral groove so that the balanced cages are drawn up and lowered down in the same operation; the hoist was originally designed to lift a 3½ ton load of salt in a half ton car suspended in a 2 ton cage 630 feet to the top of the breaker building in forty seconds. The drum caliper brake is operated manually by a steam brake; this uses a small single cylinder reciprocating engine to squeeze the caliper closed via a set of pivots and levers. The hoist is still in use for transporting personnel and light machinery to the mine's 500 foot level.

SIGNIFICANCE OF THE STRUCTURES

The steam hoist is thought to be the oldest of its kind still operating in the United States and is also a typical example of a late nineteenth century reciprocating hoist; consequently it is a candidate for inclusion as a National Historic Mechanical Engineering Landmark as designated by the American Society of Mechanical Engineers. The future of the hoist is as yet uncertain; the mining company is keen to preserve the entire engine and engine house in their present position, but need to plan for use of the existing shaft and sheave with a new electric hoist; its designation as a Landmark would provide the engine with some degree of recognition and prompt proposals for its preservation. The breaker building is still in use as an industrial facility, and will be for the foreseeable future, and therefore questions about its preservation are necessarily tempered by the practical day-to-day needs of the company.

The site of the first mine is now overgrown with dense vegetation and the remains of the structures are perched between pools and smaller sink holes. As this is the site of the first American rock salt mine it may be considered worthy of some form of recording project in the future, whether by mapping the surface remains or by archaeological excavation.

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"Avery Rock Salt Mining Company, Mine Map". 1921. AKZO Coll. No. 7-5000-020-0101.

Photographs:

AKZO Collection photographs A-1 to A-35, A-40, and one un-numbered photograph have been reproduced as 8" X 10" negatives to be deposited in the Library of Congress, as has one photograph from the Avery Island Inc. Collection - "Avery Salt Co. Breaker & Salt Rail Road" c. 1894. The AKZO Collection is located in the offices of AKZO Salt Incorporated, Avery Island, La.; the Avery Island Inc. Collection in the offices of Avery Island Inc., Avery Island, La.

All other photographs referred to in the text are available in Vertical Files "Salt" and "Salt Mines and Mining", Louisiana Collection, Hill Memorial Library, Louisiana State University, Baton Rouge, La.

Maps:

Sanborn-Perris Map Co. Ltd. New Iberia Insurance Maps. August 1899; October 1903; September 1904; February 1909; 1925; March 1931.

March 1931 Map is deposited in the Louisiana Collection, L.S.U.; the remaining maps are deposited in the Map Room of the School of Geoscience, L.S.U.